UNIT 5 *Binary Codes*   Teacher Resource Material

Key Stage: *3 or 4*

Target: *Mainstream Year 7/8   (but able pupils for the Hamming Distance)*

Teaching Notes

In terms of the use of modern codes, binary codes are of crucial importance. The analysis of error detection and correction are fundamental in today's highly technological world and the formalisation of this by use of the Hamming distance is a key concept.

The material here does not use high level mathematics but it does require logical thought (for error detection and correction) and systematic working (to calculate the Hamming distance). To this end, it is probably more appropriate for older pupils but should certainly be accessible for very able younger pupils.

Solutions and Notes

Activity 1   No, as any errors in transmission will still produce a codeword.

Activity 2   It can detect any single error but it cannot correct it; for example, (1 0 0) could have been (0 0 0) or (1 1 0) or (1 0 1) with just *one* error.

Activity 3   Here is one possible solution:

   0 0 0 0 0 , 1 1 1 0 0 , 1 0 0 1 1 , 0 1 1 1 1

Activity 4   (a)   0 0 0 0 0 0   (b)   1 1 1 0 0 0   (c)   1 1 0 0 1 1

Activity 5   It can detect 2 errors but only correct single errors.

Activity 6

Code	1	2	3	4	5
Hamming Distance	2	3	2	2	4

Activity 7

Code	Hamming Distance	Errors corrected	Errors detected
1	2	0	1
2	3	1	1
3	2	0	1
4	2	0	1
5	4	1	2

Activity 8   For $\delta = 4$, it can detect 2 errors but only correct a single error.

For $\delta = 5$, it can detect and correct 2 errors.

UNIT 5 *Binary Codes*   Teacher Resource Material (continued)

Exercise 1   1.   There are 10 codewords;   Hamming distance $= 2$.

2.   There are 35 codewords; Hamming distance $= 2$; it can detect single errors but not correct them.

3.   Hamming distance $= 4$; it can detect 2 errors but only correct single errors.